7.—ATMOSPHERIC POLLEN IN THE CITY OF PERTH AND ENVIRONS.

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ABSTRACT.

In connection with the problem of hay-fever for which pollen may be one potential cause, the day by day incidence of air-borne pollen grains in and around Perth over a period of two years is described. Pines, grasses, Cypress Pines (*Callitris*) and species of *Cupressus, Eucalyptus* and *Casuarina* make the main contribution to the pollen count. Evidence is brought forward to show that the nature and position of the surrounding vegetation is an important factor in the seasonal distribution of pollen, while weather conditions have also to be taken into account. The total pollen catch in the Perth metropolitan area is compared with the pollen catches recorded by investigators in other countries.

INTRODUCTION.

It is generally accepted that pollen is a potential cause of hay fever. This investigation was directed toward determining the types and relative seasonal abundance of pollens in selected parts of the metropolitan area in order that specific information could be available to the medical specialists on allergies.

Plants may be divided into two groups according to their method of pollination. Firstly there are the insect-pollinated types. With many species of this group it is not clear how their pollen could become airborne. Nevertheless there is evidence that at times pollen from such entomophilous plants may be present in the air in garden areas. Secondly, there are those flowers which depend upon the wind for pollination. Members of this group are by far the more important as potential producers of hay-fever. The nature of the pollen grain also makes it apparent that temperature, humidity and wind are important factors in the distribution of pollen.

AREA OF SURVEY.

Since the greatest need for atmospheric pollen research is in the urban areas where the majority of hay-fever sufferers reside, and in view of the fact that the absolute pollen frequency of the air may differ widely at a given moment in various parts of the city and fluctuates from hour to hour and day to day, a number of widely spaced stations were set up in the following locations :—

1. Midland.
2. City.
3. Scarborough.
4. Cottesloe.
5. Mt. Hawthorn.
6. Mt. Lawley.
7. South Perth.
8. Tuart Hill.
9. Fremantle.
10. Wembley Park.
11. University of W.A.

The locations of these stations are shown in the accompanying map (text fig. 3).

METHOD OF SAMPLING.

The gravity slide method as described by Wodehouse (1925), and which has been used in most of the recent atmospheric pollen surveys, was employed. Following Lima (1942), the slides were frosted, leaving a clear surface of

3·6 sq. centimetres, and then coated with methyl green glycerin jelly (Wodehouse, 1935). They were exposed in the specially made standardised device described by Durham (1946). This device makes use of two parallel planes of polished stainless steel held in position by three narrow struts.

The purpose of these planes, apart from rain protection afforded by the upper one, is to cause an even horizontal flow of air between them. The devices were supported on stands three feet high and were placed in suitable positions at the stations listed above. The level of three feet for exposure of the slides was chosen for convenience and on the assumption that it was the one which might be expected to be of greatest importance in relation to hay fever. It may be noted incidentally that it is lower than that used by workers in surveys elsewhere. Pollen from garden plants is believed to have influenced the results only slightly as most of such plants are insect pollinated and their pollen is not so commonly wind-borne. Results show a striking preponderance of the types of pollen from plants in which pollen is known to be wind-borne. The evidence also indicates that the pollen must have been conveyed some distance to the slides. Pollen collected at two high-level stations showed approximately the same incidence and types as at the low-level stations. These were :—the City station at 60 feet and the University station at 50 feet.

It is interesting in this connection to note that MacQuiddy (1934–35) demonstrated that pollen of the country surrounding Omaha in the United States of America, was found in large quantities up to and including an elevation of 3,000 feet during the pollination season.

The slides were examined at a standard magnification of 200 diameters (20 X ocular and 3 objective, Leitz), counting being facilitated by using the mechanical stage. Higher magnifications were used for identifications where necessary.

RESULTS.

A total of 1,317 slides were exposed during the period covered in the first fourteen months of the survey. From these slides a total of 16,881 pollen grains were counted. The distribution of these is shown in text fig. 1. The graph is based on the daily average number of pollen grains per slide, and corresponds with " the number of pollen grains per cubic yard of air as determined by the standard technique recommended by the National Pollen Survey Committee of the American Academy of Allergy, 1942."

Text fig. 1, showing pollen numbers reveals three fairly well defined seasonal periods. (1) A very heavy spring period, August to November. It may be noted that fluctuations occur during late August, September and part of October. These are due to weather conditions. (2) A summer period, and (3) a peak in the autumn. There is reason to believe that the December results may not represent a typical picture of the incidence of pollen for that month, since over the Christmas vacation period not all the stations were continuously operated. In the months of April, May, June and July, the pollen count was very variable in amount and spasmodic in occurrence. Relative non-availability of pollen and inclement weather militated against high incidence of atmospheric pollen. Text fig. 4 summarises graphically the monthly average number of pollen grains per day per slide.

Some attempt has been made to correlate the occurrence of atmospheric pollen with weather data. While it may be seen from text fig. 1 that a number of positive correlations can be made it should be borne in mind that there


TEXT FIG. 1
POLLEN SURVEY PERTH METROPOLITAN REGION
DAILY RAIN IN POINTS
DAILY AVERAGE POLLEN PER. SLIDE
July
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
DAILY WIND IN TOTAL MILES

are limitations of application. In this connection the following points may be noted :—(1) there must be pollen available, *i.e.*, it must be the flowering season of some species, (2) as one effect of rain is to dampen the pollen and so alter its relative availability, allowance must be made for this, (3) from the above it is clear that wind will become a factor in distribution only when factors 1 and 2 are favourable. The rainfall graph records total points per day. If additional details such as humidity and time of day at which precipitation took place could be included it is possible that more striking correlations would be observed. Correlation with wind is less obvious because as explained above wind can only influence pollen distribution when all the other factors are favourable. The figures used for wind were total daily miles as recorded at the Perth Weather Bureau.

The pollen trapping and counting was continued during the second year, on a modified scale, as a check on the results of the first year. It is interesting to observe that the pollen count over this year, while showing the same seasonal periods and pollen types represented, is much lower than for the 1948–49 season.

From information supplied by Dr. Breidahl it appeared that there was a close correlation between the lessened amount of atmospheric pollen and the number of cases of hay-fever over this period.

It has been possible to assign 95 per cent. of the pollen types examined to their correct plant families, and in many cases also the genus and species has been determined. However, in the case of families such as Gramineae and in the genus *Eucalyptus* further subdivision may only be safely made when correlated with times of flowering of the various species. This point will be referred to again later. Most of the unknowns were distributed over a very wide variety of types. None of the unknowns, however, were of sufficiently high incidence to be a potential cause of hay-fever.

The genus *Pinus* was found to be by far the most important (text fig. 2) from the standpoint of numbers at least. Pollen occurred in a very well defined period commencing in late July and extending to the beginning of November. A few isolated grains, however, appeared on the slides at periods throughout the year. These are believed to represent stale pollen grains which had either been released into the air from an earlier lodgment or which had settled slowly after wind currents had carried them to great altitudes.

The explanation of the preponderance of *Pinus* pollen lies in the presence of pine plantations as well as of individual trees in parks and private gardens throughout the metropolitan area. The other conifers, *Cupressus* and *Callitris* are both important and show a well defined season extending over August, September and October.

Grass pollen was present over the whole year with but a few breaks here and there. Text fig. 2 shows that from a slight but consistent record through August it rises to very great proportions, the peak coming in November. After an apparent lull in December (which may be due to insufficient data as indicated above) the grass pollen is again prominent on the slides until March. Considerable difficulty was experienced in classifying pollen of grasses beyond genera. While the counting of the pollen grains on the slides was proceeding, supplementary field observations were made to determine the species of plants flowering in the vicinity of the stations, particularly grasses, and studies were made of their pollen grains. It was then possible to recognise with reasonable certainty pollen belonging to the genera *Hordeum*, *Avena*, *Briza* and *Ehrharta*, but there always remained a considerable proportion that could not, with certainty, be identified beyond the Family. For this reason they were all recorded as grass pollen. In this connection it is of interest to note that Jones and Newall (1948) after a special study of the size and shape of 27 species of South African grasses also came to the conclusion that it was impossible to identify most of the common grasses by their pollen.

Some *Eucalyptus* species were associated with the grasses as the main source of pollen through the summer period. Difficulty was also experienced in identifying the species of *Eucalyptus* pollens due to :—(1) the very great similarity of pollen of different species, and (2) the spasmodic flowering times of the numerous species represented in the urban area. Consequently no attempt has been made to group *Eucalyptus* pollens into species. The writer is of the opinion that it may only be possible to classify *Eucalyptus* pollens with any degree of certainty by close observations in the field near the stations at flowering times.

Casuarina was found to have a well-defined although short season of air-borne pollen with its peak in the month of August.

Five other pollen types, *Agonis, Chamaelaucium, Acacia, Papaver,* and species of Composites, although less conspicuous on the graph (text fig. 2), at times were present in the atmosphere in apparently sufficient quantity to be potential cause of hay-fever.

All of the other families found represented on the slides, show a much lower incidence and so will not be considered further in this survey. A list of these is provided in Table I.

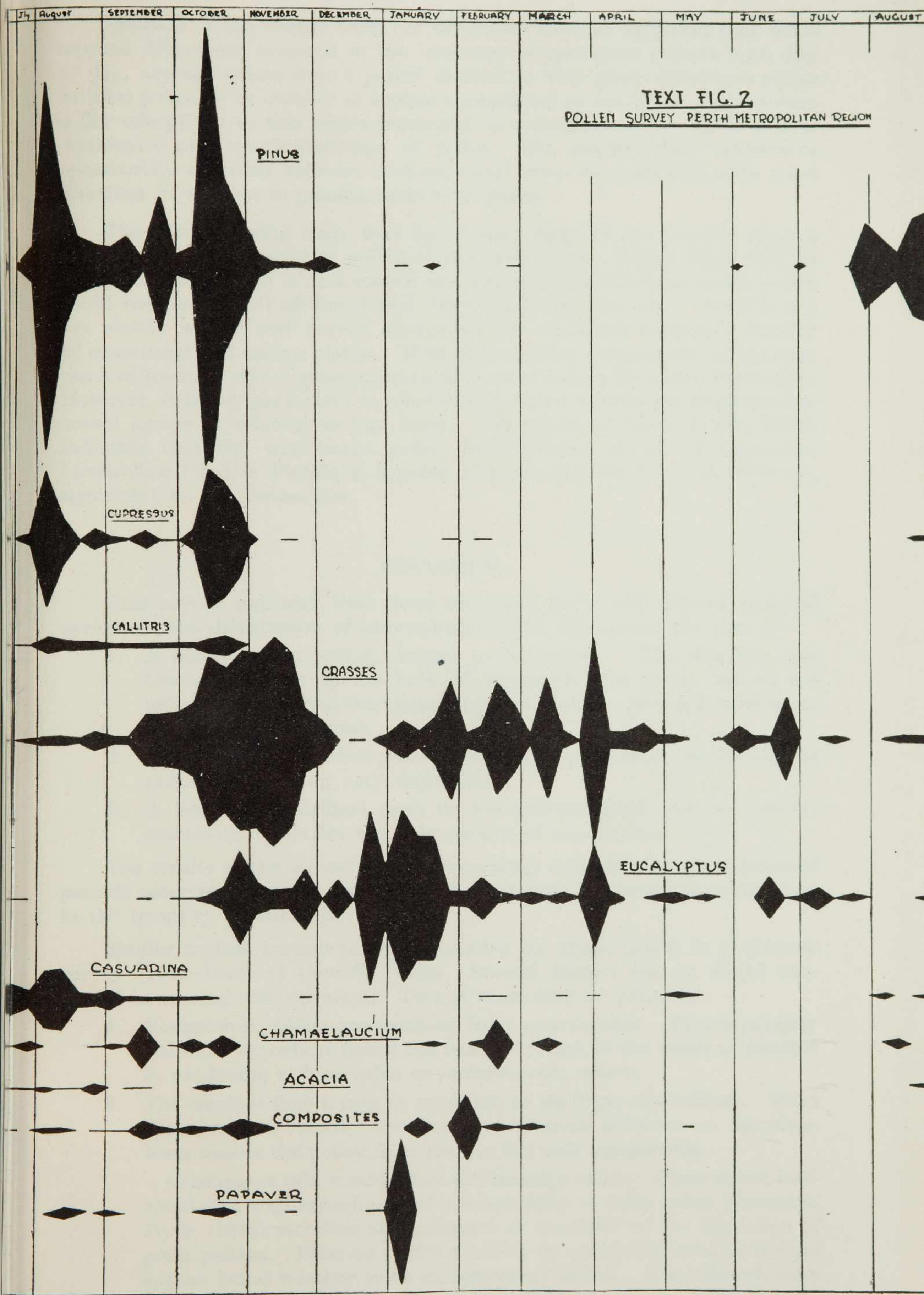
TABLE 1.

List of pollen types in order of aggregate catch expressed in percentages.

Type of Pollen.	Percentages.
Pinus	26·6
Gramineae	23·6
Cupressus	9·2
Eucalyptus	8·85
Casuarina	4·56
Compositae	2·58
Agonis	2·6
Chamaelaucium	2·2
Papaver	1·7
Pelargonium	1·53
Callitris	1·53
Phoenix	0·85
Zea Mays	0·77
Calendula	0·74
Lathyrus odoratus	0·61
Banksia	0·6
Trifolium	0·5
Melia	0·5
Acacia	0·5

The following types rated less than 0·5 per cent

Hardenbergia.
Conostylis.
Stirlingia.
Nasturtium.
Antirrhinum.
Coreopsis.
Anigozanthos.
Triglochin.
Erythrina.



Jly
August
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
TEXT FIG. 2
POLLEN SURVEY PERTH METROPOLITAN REGION
PINUS
CUPRESSUS
CALLITRIS
GRASSES
EUCALYPTUS
CASUARINA
CHAMAELAUCIUM
ACACIA
COMPOSITES
PAPAVER